CLAIMS

I/We claim:

[c1] 1. A system for processing microfeature workpieces, comprising:

a vessel configured to carry a processing fluid, the vessel having a generally planar process location positioned to receive a microfeature workpiece;

a workpiece support positioned at least proximate to the vessel, the workpiece support being positioned to carry a microfeature workpiece at the process location of the vessel;

a paddle chamber in fluid communication with the vessel, the paddle chamber having an opening at the process location to receive a microfeature workpiece, the paddle chamber having a base portion facing the process location and being spaced apart from the process location by a first distance along a first axis generally normal to the process location; and

a paddle device disposed in the paddle chamber, the paddle device having at least one paddle positioned at least proximate to the process location, the at least one paddle extending for a second distance generally parallel to the first axis, the second distance being at least 30% of the first distance, and wherein at least one of the workpiece support and the at least one paddle is movable along a generally linear second axis to agitate processing fluid at the process location while the workpiece support carries a microfeature workpiece.

[c2] 2. The system of claim 1 wherein the second distance is at least 70% of the first distance.

[c3] 3. The system of claim 1 wherein the second distance is at least 90% of the first distance.

[c4] 4. The system of claim 1 wherein the paddle chamber includes a plurality of sidewall portions extending downwardly from the process location to the base portion to at least partially enclose the paddle device.

[c5] 5. The system of claim 1 wherein a gap between the process location and an upper extremity of the at least one paddle is about five millimeters or less.

[c6] 6. The system of claim 1 wherein a gap between the base portion and a lower extremity of the at least one paddle is about five millimeters or less.

[c7] 7. The system of claim 1 wherein a first gap between the process location and an upper extremity of the at least one paddle is about five millimeters or less, and wherein a second gap between the base and a lower extremity of the at least one paddle is about five millimeters or less.

[c8] 8. The system of claim 1 wherein the at least one paddle is spaced apart from the process location by a first gap having a first gap dimension, and wherein the at least one paddle is spaced apart from the base portion by a second gap having a second gap dimension different than the first gap dimension.

[c9] 9. The system of claim 1 wherein a distance between the base portion and the process location is less than about 30 millimeters.

[c10] 10. The system of claim 1 wherein a distance between the base portion and the process location is from about 10 millimeters to about 15 millimeters.

[c11] 11. The system of claim 1 wherein at least part of the base portion is porous.

[c12] 12. The system of claim 1, further comprising a magnet positioned proximate to the process location to orient material deposited on a microfeature workpiece at the process location.

[c13] 13. The system of claim 1 wherein the paddle chamber includes a plurality of sidewall portions extending downwardly away from the process location to the base portion, and wherein the base portion includes a first surface facing toward the process location and a second surface facing opposite from the first surface, and wherein the second surface is inclined to have a higher elevation toward a perimeter of the process location than toward a center of the process location.

[c14] 14. The system of claim 1 wherein the paddle chamber includes a plurality of sidewall portions extending downwardly away from the process location, at least one of the sidewall portions including a fluid entrance at least proximate to the process location, at least one of the sidewall portions further including a fluid exit at least proximate to the process location, with the at least one paddle positioned between the fluid entrance and the fluid exit.

[c15] 15. The system of claim 1 wherein the paddle device is movable relative to the workpiece support back and forth along a linear path.

[c16] 16. The system of claim 1 wherein the workpiece support is positioned to rotate the microfeature workpiece about an axis generally normal to a face of the microfeature workpiece.

[c17] 17. A system for processing microfeature workpieces, comprising:

a vessel configured to carry a processing fluid, the vessel having a process location positioned to receive a microfeature workpiece;

a workpiece support positioned at least proximate to the vessel, the workpiece support being positioned to carry a microfeature

workpiece at the process location of the vessel during processing; and

a paddle device having a plurality of paddles with corresponding spaced apart paddle surfaces positioned at least proximate to the process location, wherein at least one of the workpiece support and the paddle device is movable back and forth along a linear path relative to the other while the workpiece support carries a microfeature workpiece.

[c18] 18. The system of claim 17 wherein the spaced apart paddle surfaces are coupled to each other to move as a unit relative to the workpiece support.

[c19] 19. The system of claim 17 wherein the process location is positioned at a process plane and wherein the spaced apart paddle surfaces are inclined at an acute angle relative to the process plane.

[c20] 20. A system for processing microfeature workpieces, comprising:

a vessel configured to receive a processing fluid, the vessel having a generally planar process location positioned to receive a microfeature workpiece;

a workpiece support positioned at least proximate to the vessel, the workpiece support being positioned to releasably carry a microfeature workpiece at the process location of the vessel; and

a paddle device having at least one paddle proximate to the process location, the at least one paddle having a first surface and a second surface facing opposite from the first surface, the first and second surfaces being canted outwardly and downwardly away from an axis positioned between the surfaces and normal to the process location, at least one of the workpiece support and the at least one paddle being movable relative to the other.

[c21] 21. The system of claim 20 wherein the at least one paddle has a generally diamond shaped cross-section when intersected by a plane generally normal to the process location.

[c22] 22. The system of claim 20 wherein the at least one paddle has a generally triangular cross-sectional shape when intersected by a plane generally normal to the process location.

[c23] 23. The system of claim 20 wherein at least one of the first and second surfaces is curved.

[c24] 24. The system of claim 20 wherein the at least one paddle includes one of a plurality of paddles.

[c25] 25. The system of claim 20, further comprising a first electrode in fluid communication with the process location, and wherein the workpiece support includes a second electrode positioned to electrically couple with a microfeature workpiece when the workpiece support carries the microfeature workpiece.

[c26] 26. The system of claim 20, further comprising a magnet positioned at least proximate to the process location, the magnet being positioned to impose a magnetic field on a microfeature workpiece when the microfeature workpiece is carried at the process location to orient material deposited on the microfeature workpiece.

[c27] 27. A system for processing microfeature workpieces, comprising:

a vessel configured to receive a processing fluid, the vessel having a generally planar process location positioned to receive a microfeature workpiece, the microfeature workpiece having a maximum width at the process location;

a workpiece support positioned at least proximate to the vessel, the workpiece support being positioned to releasably carry a microfeature workpiece at the process location of the vessel;

a paddle device having at least one paddle proximate to the process location, at least one of the at least one paddle and the workpiece support being movable relative to the other along a generally linear axis; and

a controller operatively coupled to at least one of the paddle device and the workpiece support, the controller being configured to move at least one of the at least one paddle and the workpiece support relative to the other along the generally linear axis by a distance that is less than the maximum width.

[c28] 28. The system of claim 27 wherein the at least one paddle is configured to reciprocate relative to a microfeature workpiece having a maximum width of about 300 millimeters, and wherein the at least one paddle is configured to accelerate and decelerate at about 8 meters/second^2.

[c29] 29. The system of claim 27 wherein the controller is configured to move the at least one paddle relative to the workpiece support in a reciprocal manner along a generally linear axis with a stroke of a relative motion between the at least one paddle and the workpiece support changing between at least two successive reciprocations.

[c30] 30. A system for processing microfeature workpieces, comprising:

a vessel configured to receive a processing fluid, the vessel having a process location positioned to receive a microfeature workpiece;

a workpiece support positioned at least proximate to the vessel, the workpiece support being positioned to releasably carry a microfeature workpiece at the process location of the vessel;

a paddle device having at least one paddle, with at least one of the at least one paddle and the workpiece support being movable relative to the other along a generally linear axis; and

a controller operatively coupled to the at least one of the paddle device and the workpiece support, the controller being configured to move the at least one of the at least one paddle device and the workpiece support relative to the other in a reciprocal manner along the generally linear axis, with a stroke of the relative motion changing between at least two successive reciprocations.

[c31] 31. The system of claim 30 wherein the controller is configured to move a center of the stroke of the relative motion to from two to twelve center locations, with each center location different than the immediately preceding center location.

[c32] 32. The system of claim 30 wherein the controller is operatively coupled to the paddle device.

[c33] 33. The system of claim 30 wherein the at least one paddle is one of a plurality of paddles of the flow control device, and wherein the controller is operatively coupled to the flow control device to move each of the paddles together, with a spacing between adjacent paddles remaining constant as the flow control device moves.

[c34] 34. A system for processing microfeature workpieces, comprising:

a vessel configured to receive a processing fluid, the vessel having a process location positioned to receive a microfeature workpiece;

a workpiece support positioned at least proximate to the vessel, the workpiece support being positioned to releasably carry a microfeature workpiece at the process location of the vessel; and

a paddle device having a plurality of paddles, with at least one of the workpiece support and the plurality of paddles being movable

relative to the other along a generally linear motion axis, wherein at least a first one of the paddles is elongated along a first axis and at least a second one of the paddles is elongated along a second axis non-parallel to the first axis.

[c35] 35. The system of claim 34 wherein the plurality of paddles includes a first paddle elongated along a first axis and a second paddle elongated along a second axis generally orthogonal to the first axis, and wherein the motion axis is inclined at a first acute angle relative to the first axis, the motion axis being inclined at a second acute angle relative to the second axis.

[c36] 36. A system for processing microfeature workpieces, comprising:

a vessel configured to receive a processing fluid, the vessel having a generally planar process location positioned to receive a microfeature workpiece;

a workpiece support positioned at least proximate to the vessel, the workpiece support being positioned to releasably carry a microfeature workpiece at the process location of the vessel; and

a paddle device having a first paddle and a second paddle, with at least a portion of the second paddle being spaced apart from the first paddle, the first paddle having a first shape and size and the second paddle having a second shape and size, with the first shape being different than the second shape, or the first size being different than the second size, or both.

[c37] 37. The system of claim 36 wherein the process location has an inner region positioned to be generally proximate to an inner region of the microfeature workpiece, and an outer region positioned to be generally proximate to an outer region of the microfeature workpiece, and wherein the second paddle is positioned inwardly from the first paddle, the first paddle being smaller than the second paddle.

[c38] 38. The system of claim 36 wherein the first shape is geometrically similar to the second shape and wherein the first size is different than the second size.

[c39] 39. The system of claim 36 wherein the workpiece support includes a generally circular seal positioned to extend around a peripheral region of the microfeature workpiece, and wherein the first paddle is elongated along an elongation axis and is positioned pass over the seal with the elongation axis generally tangent to a portion of the seal, and wherein the second paddle is positioned inwardly from the first paddle, still further wherein the first paddle is smaller than the second paddle.

[c40] 40. A system for processing microfeature workpieces, comprising:

a vessel configured to receive a processing fluid, the vessel having a generally planar process location positioned to receive a microfeature workpiece;

a workpiece support positioned at least proximate to the vessel, the workpiece support being positioned to releasably carry a microfeature workpiece at the process location of the vessel; and

a paddle device having at least one paddle, at least one of the workpiece support and the at least one paddle being movable relative to the other along a generally linear motion axis, the at least one paddle being at least partially transmissive to the processing fluid to allow the processing fluid to pass through the at least one paddle as a result of relative motion between the at least one paddle and the workpiece support.

[c41] 41. The system of claim 40 wherein the at least one paddle includes a generally porous material.

[c42] 42. The system of claim 40 wherein the at least one paddle includes an electrically conductive material.

[c43] 43. The system of claim 40 wherein the at least one paddle includes an electrically insulative material.

[c44] 44. The system of claim 40 wherein the at least one paddle has a first surface, a second surface facing opposite from the first surface, and a plurality of highly flow-restrictive apertures extending through the at least one paddle from the first surface to the second surface.

[c45] 45. A system for processing microfeature workpieces, comprising:

a vessel configured to receive a processing fluid, the vessel having a generally planar process location positioned to receive a microfeature workpiece;

a workpiece support positioned at least proximate to the vessel, the workpiece support being positioned to releasably carry a microfeature workpiece at the process location of the vessel; and

a paddle device having at least one paddle positioned in the vessel and being movable along a generally linear motion axis relative to the process location, the at least one paddle being elongated along a paddle axis, the at least one paddle having a first shape and size at a first location along the paddle axis and a second shape and size at a second location along the paddle axis, with the first shape being different than the second shape, or the first size being different than the second size, or both.

[c46] 46. The system of claim 45 wherein the first shape is geometrically similar to the second shape and wherein the first size is different than the second size.

[c47] 47. The system of claim 45 wherein the at least one paddle has a first end region, a second end region spaced apart from the first end region along the paddle axis, and an intermediate region between the first and second end regions, the first and second end regions extending generally normal to the process location by a first distance, the intermediate region extending generally normal to the process location by a second distance greater than the first distance.

[c48] 48. A method for processing a microfeature workpiece, comprising:

positioning a microfeature workpiece in fluid communication with a processing fluid and proximate to at least one paddle, the microfeature workpiece having a maximum width; and

reciprocating at least one of the microfeature workpiece and the at least one paddle relative to the other along a generally linear motion path, with each of at least two temporally adjacent strokes of the motion covering a distance less than the maximum width.

[c49] 49. The method of claim 48 wherein positioning a microfeature workpiece proximate to at least one paddle includes positioning the microfeature workpiece proximate to a plurality of paddles.

[c50] 50. The method of claim 48, further comprising reciprocating the at least one paddle over two successive strokes, with a center point of a first stroke being at a different location than a center point of a second, successive stroke.

[c51] 51. A method for processing a microfeature workpiece, comprising:

positioning a microfeature workpiece in fluid communication with a processing fluid and proximate to at least one paddle;

reciprocating at least one of the microfeature workpiece and the at least one paddle relative to the other along a generally linear axis; and

changing a reciprocal motion of the at least one of the microfeature workpiece and the at least one paddle so that at least one stroke of

the reciprocal motion covers an envelope different than an envelope covered by a subsequent stroke.

[c52] 52. The method of claim 51 wherein changing a reciprocal motion includes changing an envelope covered by successive strokes by from two to twelve times in a pattern before repeating the pattern.

[c53] 53. The method of claim 51 wherein reciprocating at least one of the microfeature workpiece and the at least one paddle includes reciprocating the at least one paddle.

[c54] 54. The method of claim 51 wherein reciprocating at least one of the microfeature workpiece and the at least one paddle includes reciprocating a plurality of paddles.

[c55] 55. A method for manufacturing a processing apparatus for microfeature workpieces, comprising:

positioning a workpiece support at least proximate to a vessel, the workpiece support being configured to carry a microfeature workpiece at a process location of the vessel, the vessel being configured to receive a processing fluid;

selecting a characteristic of a paddle device to have a selected effect on a diffusion layer of the processing fluid adjacent to the microfeature workpiece, the paddle device including at least one paddle, the characteristic including at least one of a number of paddles of the paddle device, a spacing between the process location and the at least one paddle, a stroke envelope of the at least one paddle relative to the process location, and a stroke schedule of the at least one paddle relative to the process location; and

mounting the paddle device at least proximate to the process location, with at least one of the paddle device and the workpiece support being movable relative to the other along a generally linear axis.

[c56] 56. The method of claim 55, further comprising selecting the paddle device to include six paddles, each having two oppositely facing, downwardly canted paddle surfaces.

[c57] 57. The method of claim 55, further comprising selecting a stroke envelope of the at least one paddle to be generally rectilinear and to have a length less than a maximum diameter of a microfeature workpiece carried by the workpiece support.

[c58] 58. A method for manufacturing a processing apparatus for microfeature workpieces, comprising:

positioning a workpiece support at least proximate to a vessel, the workpiece support being configured to carry a microfeature workpiece at a process location of the vessel, the vessel being configured to receive a processing fluid;

selecting a number of paddles of a paddle device based on a selected stroke length of the paddles, or selecting a stroke length of the paddles based on a number of the paddles; and

positioning the paddle device with a plurality of the paddles at least proximate to the process location, at least one of the paddle device and the workpiece support being movable relative to the other along a generally linear motion axis.

[c59] 59. The method of claim 58, further comprising positioning a magnet proximate to the process location to orient material deposited on the microfeature workpiece.